REMARKS

Upon entry of this amendment, claims 7-15, 17, and 22-33, and 35-40 are pending. Claim 7 has been amended. Claims 35-40 have been added. Claims 10-12 have been withdrawn. Claims 1-6, 16, 18-21, and 34 have been canceled.

Support for the amendment to claim 7 appears at least at ¶0052-0053. It is noted that the amendment to claim 7 does not change the scope of the claim given that "quinone molecule derivative" is defined in the specification as a quinone molecule "modified with a functional group capable of bonding with a polymer or an enzyme" (¶0052). The specification further provides that "the derivative ... must be modified with a functional group capable of bonding with a polymer described below or a biopolymer such as an enzyme" (¶0053). In the interest of furthering prosecution, such definition has been introduced into the claims.

Support for new claim 35 appears at least at ¶0084. Support for new claim 36 appears at least at ¶0086. Support for new claim 37-38 appears at least at ¶0085. Support for new claims 39-40 appears at least at canceled claim 34.

No new matter has been added by way of this response.

Election/Restrictions

As noted above, claims 7-15, 17, and 22-33 are pending, with claims 7-9, 13-15, 17, and 22-33 currently under examination.

Claims 10-12, directed to non-elected species, are withdrawn. Applicants reserve the right to request REJOINDER, under MPEP § 821.04, and examination of the non-elected species upon allowance of any claims generic to the non-elected species.

Claims 16 and 34, directed to non-elected Invention Group II, have been canceled herein. Applicants reserve the right to pursue such non-elected canceled subject matter in a subsequently filed application, such as a Divisional application.

Claim Rejections under 35 U.S.C. §103(a)

Applicants respectfully traverse and, for the following reasons, request reconsideration and withdrawal of the rejection of claims 7-9, 13-15, 17, and 22-33 under 35 U.S.C. §103(a) as being unpatentable over Miki et al. (1989) Analytical Sciences 5(3), 269 ("Miki") in view of Kawabata Yuji, JP 2000-133297, May 12, 2000 ("Yuji").

To establish obviousness of a claim, the prior art must disclose or suggest each element of the claim; there must be some reason that would have prompted one or ordinary skill in the art to combine the elements and/or modify a reference(s) so as to reach the requirements of the claim; and there must have been a reasonable expectation of success of the combination and/or modification. MPEP § 2143; *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. __, Slip Op No. 04-1350, 119 Fed. Appx. 282 (April 30, 2007).

It is first noted that Yuji, JP 2000-133297, is a foreign patent application reference having an English abstract and Japanese specification. Under MPEP § 706.02(II), the record must be clear as to whether the Examiner is relying upon the abstract or the full text document to support a rejection. Applicants respectfully request the Office to clarify whether Yuji is relied upon for the abstract only or the entire reference. If the entire reference is relied upon, Applicants respectfully request the Office provide the full text document and translation in the next Action, as required under MPEP § 706.02(II). If the abstract only is relied upon, Applicants respectfully request the Office to justify why the underlying document is not being used to support the rejection (*see* MPEP § 706.02(II)).

The present application demonstrates that immobilization of a mediator through a modified functional group of a quinone molecule derivative prevents diffusion of the mediator, allows increased amounts of immobilized mediator, and provides for efficient redox cycle in a biofuel cell (*see* ¶0079).

Claim 7 recites an electrode comprising a mediator, said mediator comprising a quinone molecule derivative, wherein the quinone molecule derivative is a quinone molecule modified with at least one functional group capable of bonding with a polymer

or a biopolymer; the mediator is immobilized through bonding of the at least one modified functional group of the quinone molecule derivative; and the mediator mediates electron transfer between at least one enzyme and an electrode.

Miki fails to teach or suggest all elements of claim 7

Miki, the primary reference cited by the Office, is directed to diaphorase-containing carbon paste electrodes with entrapped mediator. The mediator of Miki is merely sealed in a carbon paste rather than immobilized, as required in claim 7. As such, the mediator of Miki elutes from the electrode causing long-term degradation of performance (*see* ¶0012 of present published application). Further, Miki discloses 2-methyl-1,4-napthoquinone (VK) as a mediator. The VK compound is not a quinone molecule "derivative", *i.e.*, a quinone molecule modified with at least one functional group capable of bonding with a polymer or a biopolymer, as defined in the present specification and as required by claim 7.

Miki fails to teach or suggest a quinone molecule modified with at least one functional group capable of bonding with a polymer or a biopolymer (*i.e.*, a quinone molecule derivative), as required by claim 7. And Miki fails to teach or suggest a mediator immobilized through bonding of the functional group of the quinone molecule derivative, as required by claim 7.

Yuji fails to teach or suggest all elements of claim 7

The Office relies on Yuji to overcome the inadequacies of the primary reference Miki. Contrary to the Office's assertion, Yuji does not teach the immobilized mediator of claim 7.

Yuji discloses a mediator for a biofuel cell composed of a compound having a thionine skeleton and a 2-hydroxy-1,4-naphthoquinone skeleton. In contrast to claim 7, the mediator of Yuji is attached directly to the electrode and not to a polymer or enzyme. Yuji immobilizes the mediator on the electrode by subjecting the electrode to plasma treatment and further subjecting the electrode to treatment with 3-aminopropyltriethoxysilane, to thereby form an electrode with an amino group

introduced to the electrode surface. The immobilization of the mediator of Yuji further involves: immobilizing long-chain alcohol on a carbon electrode surface through dehydration condensation; and immobilizing the immobilized long-chain alcohol and 2-hydroxy-1,4-naphthoquinone through dehydration condensation.

As discussed in the present application (*see* ¶0010), immobilization as in Yuji involves complicated operations, and has many practical problems. The immobilization of Yuji involves monomolecular layer modification (*i.e.*, the mediator is bonded directly to a functional group on the electrode material surface), and hence the amount of the mediator immobilized is small and results in limited reactivity. In contrast, the mediator of claim 7 is bound to a polymer or enzyme through the modified functional group of the quinone molecule. Such bonding provides for increased amounts of immobilized mediator in the electrode of claim 7, as compared to the electrode directly bound by mediator as in Yuji.

As shown above, neither the primary reference Miki nor the secondary reference Yuji, alone or in any known combination, teach or suggest all required features of claim 7.

No reason to modify Miki and/or Yuji to reach all elements of claim 7

Furthermore, there is no reason provided to modify the cited references so as to reach all requirements of claim 7. The Office asserts that, under KSR Int. Co. v. Teleflex Inc., 82 USPQ2d 1385 (2007), there is no obligation to satisfy the teaching, suggestion, or motivation test. But the Office must still provide some reason to modify or combine cited references so as to reach all requirements of the claims. In a determination of obviousness, the proper question is whether one of ordinary skill in the art would have seen an obvious benefit to upgrading conventional biocatalytic electrodes, such as those in Miki and Yuji, so as to reach the requirements of claim 7 (*see KSR Int'l Co.*, at 6). The mere fact that references can be combined or modified does not render the resultant combination obvious unless there is *some reason that suggests the desirability* of the combination. MPEP §2143.01(III).

The Office has failed to show a reason to upgrade the conventional VK mediator of Yuji to a quinone molecule *derivative*, *i.e.*, a quinone molecule *modified* with at least one functional group capable of bonding with a polymer or a biopolymer, as required by claim 7. As shown above, the modified functional group of the quinone molecule derivative allows binding to a polymer or enzyme, thereby providing, *inter alia*, increased amounts of immobilized mediator in the electrode of claim 7, as compared to an electrode mediator directly bound to the electrode surface.

The Office has also failed to show a reason to upgrade the conventional mediator/electrode attachment protocols, such as in Yuji, to mediator bonding to a polymer or enzyme through the modified functional group of a quinone molecule derivative, as required by claim 7. As shown above, bonding of the mediator to a polymer or enzyme provides for increased amounts of immobilized mediator, which in turn enhances performance of the electrode and biofuel cell. Binding through the modified functional group of the quinone to a polymer or enzyme also provides for less complex binding reactions, as compared to processes such as in Yuji.

In summary, because neither Miki nor Yuji, alone or in any known combination, teach or suggest all requirements of claim 7, and there is no reason provided to modify Miki and/or Yuji so as to reach the requirements of claim 7, such claim has not been shown as *prima facie* obvious over the cited references. The above argument applies equally to claim 7 and claims dependent thereon, such as claims 8-9, 13-15, 17, and 22-33.

Additional Claims

Additional claims have further patentable features.

For example, claim 13 recites that the mediator and the enzyme are immobilized on the electrode by a polymer and a crosslinking agent. The Office asserts that Yuji discloses such feature. But as discussed above, the mediator of Yuji is attached directly to the electrode and not to a polymer and a crosslinking agent. Yuji immobilizes the mediator on the electrode by subjecting the electrode to plasma treatment and further subjecting the electrode to treatment with 3-aminopropyltriethoxysilane, to

thereby form an electrode with an amino group introduced to the electrode surface. The immobilization of the mediator of Yuji further involves: immobilizing long-chain alcohol on a carbon electrode surface through dehydration condensation; and immobilizing the immobilized long-chain alcohol and 2-hydroxy-1,4-naphthoquinone through dehydration condensation. As such, the mediator of Yuji is immobilized directly on the electrode surface, and not immobilized on the electrode by a polymer and a crosslinking agent, as required by claim 13. As such, this claim is not prima facie obvious over Miki and/or Yuji.

As another example, claim 14 recites that the mediator and the enzyme are immobilized on the electrode by a polyvinylimidazole polymer and a crosslinking agent. As discussed above, the cited references do not disclose immobilization of the mediator via a polymer and crosslinking agent, much less a polyvinylimidazole polymer. And there is no suggestion to modify the references to reach the immobilization through a polyvinylimidazole polymer and a crosslinking agent. As such, this claim is not prima facie obvious over Miki and/or Yuji.

As another example, claim 15 recites that the mediator and the enzyme are immobilized on the electrode by a polymer (*e.g.*, polyvinylimidazole) and a polyethylene glycol diglycidyl ether (PEGDGE) crosslinking agent. As discussed above, the cited references do not disclose immobilization of the mediator via a polymer and crosslinking agent, much less a PEGDGE crosslinking agent. And there is no suggestion to modify Miki and/or Yuji so as to reach mediator immobilization through a polymer (*e.g.,* polyvinylimidazole) and a PEGDGE crosslinking agent. As such, this claim is not prima facie obvious over Miki and/or Yuji.

As another example, claims 22, 23, and 24 recite that the quinone molecule derivative of the mediator is a naphthoquinone molecule *derivative*; a AQS *derivative* or VK3 *derivative*; and a VK3 *derivative*, respectively. As defined in the specification, and required in the claims, a quinone molecule *derivative* is a quinone molecule modified with at least one functional group capable of bonding with a polymer or a biopolymer. The Office asserts that VK3 molecule of Miki is the same as that of claim 22-24. But the VK3 molecule of Miki is not a VK3 *derivative* (*i.e.*, a VK3 molecule modified with at least

one functional group capable of bonding with a polymer or a biopolymer), as required by the claims. And there is no suggestion to modify the references to reach a naphthoquinone molecule derivative; a AQS derivative or VK3 derivative; or a VK3 derivative, as required by claims 22, 23, and 24, respectively. As such, these claims are not prima facie obvious over Miki and/or Yuji.

Claims 25-33 recite various functional group modifications of the quinone molecule derivative. The Office asserts these modifications would be prima facie obvious absent patentable differences from the cited references. As described above, the functional group modification of the quinone molecule derivative provides for bonding to a polymer or a biopolymer. In contrast, the VK mediator of Miki is merely entrapped (i.e., unbound) and the VK3 mediator of Yuji is directly bound to the electrode surface resulting in a decreased amount of bound mediator. Thus there exists a patentable difference between the binding characteristics of the quinone molecule derivatives of claims 25-33 and the VK and VK3 molecules of Miki and Yuji.

CONCLUSION

Applicants respectfully request withdrawal of the rejections and believe that the claims as presented represent allowable subject matter. If the Examiner desires, Applicants welcome a telephone interview to expedite prosecution. Applicants petition the Office for a three month extension of time and submit herewith the requisite extension fee paid by credit card vie EFS-Web. The Commissioner is hereby authorized to deduct any deficiency not covered by this credit card payment or credit any overpayment with respect to this response to Deposit Account No. 19-3140.

Respectfully submitted,

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